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Simplifying the Opaqueness and Dilemma of the Computing Disciplines for the Common Person in Society

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ABSTRACT

The computing fields have grown increasingly influential in modern times, yet their complexities and technical terms can prove problematic for the public to comprehend. This paper proposes to bridge this gap, introducing readers to the five major computing disciplines as per the Association of Computing Machinery (ACM), 2016: computer science, Information System, software engineering, computer engineering, and information technology. An additional more recent discipline which does not fall under the 5 ACM disciplines, Information Communication Technology was also introduced. The paper first examines the evolution of the Computing disciplines from the 1960s. Then the paper briefly discusses each discipline and how the disciplines overlap with each other through using secondary data materials. A section on the new and emerging computing technologies outlines the recognition status by the society. The interdisciplinary nature of the computing disciplines necessitated the need to simplify it. Thus, a table was done which summarized various works of various researchers who had researched on the computing disciplines.

Keywords: Computer disciplines, computer science, information sciences, Software Engineering, Computer Engineering, Information Technology, Information Communication Technology

Abbreviations

- ACM – Association for Computing Machinery
- CE – Computer Engineering
- CS – Computer Science
- EE – Electrical Engineering
- ICT – Information Communication Technology
- IS – Information System
- IT – Information Technology
- SE – Software Engineering

INTRODUCTION

Background of computing disciplines

Computing, as defined by the Association for Computing Machinery (ACM) and the Institute of Electrical

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and Electronics Engineers (IEEE) in 2016, encompasses any activity that involves, benefits from, or creates computing. This field is extensive and encompasses a wide range of disciplines.

The scope of computing involves the creation of hardware and software systems, utilizing these systems for data storage and processing, as well as supporting various activities. The interdisciplinary nature of computing is evident in its strong reliance on knowledge and abilities from fields like mathematics, sciences, engineering, and business. It is impractical for an individual to become proficient in all these areas because of how broad and deep they are. Therefore, computing professionals typically specialize in specific domains within the field (ACM et al., 2006; Ramos-Torres, 2018).

In 2005, the ACM recognized five primary computing disciplines: computer engineering (CE), computer science (CS), software engineering (SE), information systems (IS), and information technology (IT), with the recommendation to include cybersecurity as a specialized area (Gichuki et al., 2019). Each of these disciplines focuses on distinct aspects of computing, collectively enabling the development, management, and enhancement of modern technological systems. The evolution of these disciplines, from early individual systems to the complex interconnected networks that underpin our society, underscores the need to comprehend and appreciate their unique characteristics (Ramos-Torres, 2018).

Furthermore, additional computing-related fields have emerged or gained relevance over the past two decades, prompting consideration for their inclusion within the computing family of disciplines. Two noteworthy examples are cybersecurity and data analytics (or data science). Cybersecurity has already garnered attention, with Accreditation Board for Engineering & Technology's (ABET's) Computing Accreditation Commission approving program criteria for cybersecurity in 2018 after an extensive review and public comment process (ABET, 2017 as cited in Ramos-Torres, 2018). Some computing programs have piloted these criteria, both for existing programs and those in development. The growing number of computing disciplines has introduced complexities for students choosing their areas of study, universities determining which disciplines to incorporate into their academic programs, and employers crafting job descriptions and hiring suitable candidates. Consequently, there is a pressing need for clarification and guidance in this evolving landscape (Ramos-Torres, 2018).

Overall, the computing discipline encompasses a wide array of fields and specialties, and its evolution has been marked by advancements in technology and the emergence of new disciplines such as cybersecurity and data analytics. Understanding the historical context and the significance of these disciplines is vital for making informed decisions regarding academic pursuits, career paths, and program development.

EVOLUTION OF THE COMPUTING DISCIPLINES

Study by Gichuki et al, (2019) explained that the computing disciplines evolved as early as the 1960s when universities such as Stanford and Carnegie Mellon University (CMU) set up computer science departments. Since then, this has brought about a continuous evolution of the field. (Gichuki et al, 2019). Similar trend has been observed in Kenya as well, just like the rest of the world, all the way up to the present day.

A brief overview of the evolution of computing disciplines is as follows:

Before the 1990s

In the 1960s, two computing fields evolved in other parts of the world: Computer Science (CS) and Information Systems (IS). Electrical Engineering (EE) also evolved around the same time. EE is also a closely related discipline in computing. (Lunt & Ekstrom, 2008). Computer Engineering (CE) evolved from EE in the late 1970s, but it did not grow to become a discipline until in the 1990s. (Ramos-Torres, 2018)

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Compared to the rest of the world, very few people in Kenya were knowledgeable about the computing discipline in the 1960s. In Kenya computing was mainly taught through mathematics-related programs. (Wabwoba & Nambiro, 2018). At the time, CS was seen as a mathematics field and IS was regarded as a business discipline. To take computer courses in Kenya, individuals needed to have strong analytical skills and perform well in mathematics. Much of the instruction for computing courses focused on programming. This rigor and attention to principles eventually led to the evolution of Software Engineering (SE) in the late 1980s.

Additionally, CE was established as a separate discipline due to the demand for products from CS and EE communities coupled with the need to program computer hardware at the machine level and the advances in electronics. Despite these quick changes, many people who did not have computing nor engineering could not differentiate between EE and CE. (Wabwoba & Nambiro, 2018).

During the 1990s

Critics regarded computing as a field for technicians or a tool for mathematicians in the early 1990s, and very few people thought it was an academic field. Kenya soon adopted CS, IS, and computer engineering/technology as separate subjects of study, claim Wabwoba & Nambiro (2018). On-the-job training became the norm as the need for qualified CS graduates, particularly in the finance industry, outstripped supply.

The growth of the Information Technology (IT) field, which is thought to have evolved from the Business School, was facilitated by the advent of the World Wide Web (WWW) in the mid-1990s. 2008 (Lunt & Ekstrom). It was not until the late 1990s that IT started to gain traction in Kenya because the capacity to use a computer connected to network system presented a unique challenge to the computing disciplines. This made the adoption of IS and IT as separate disciplines necessary. (Wabwoba & Nambiro, 2018).

The five main computing disciplines have now been adopted as a result of these changes to the environment of the computing disciplines: CS, IT, IS, CE and SE. (ACM, 2016). The same disciplines are followed in Kenya as well (Wabwoba & Nambiro, 2018). This has now expanded the opportunities available to students and educational institutions.

Post 2010s

A sixth computing field known as Information and communication technology (ICT) emerged in the 2010s.The communication, information, and technology theories have been the inspiration for this discipline's philosophy. These include technologies such as Computer software, networking, telecommunications, Internet, programming, and IS."(Wabwoba & Nambiro, 2018).

ICT is a by-product of two important programs of study. Communication technology (CT) and IT.CT examines how computers or other machines communicate with one another or with humans regardless of their physical location. On the other handIT focuses on the computer and the various waysit stores, retrieves, and modifies data. This includes the steps required to transfer data between computers using a radio, a phone, an email, or any other methods. (Wabwoba & Nambiro, 2018).

OVERVIEW OF THE COMPUTING DISCIPLINES AND THEIR DILEMMA

Computer Science (CS)

Computer Science (CS) is a field of study that revolves around the exploration of computing theory. Its primary objective is to address fundamental questions such as the capabilities of computer systems and

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whether specific tasks can be accomplished using these systems (Wabwoba & Nambiro, 2018). CS approaches computing from a scientific standpoint, aiming to develop effective solutions to computing problems, devise innovative applications of computers, and design and implement software through programming.

As a diverse domain, CS encompasses various computing disciplines, each presenting its unique challenges and opportunities. It encompasses theoretical and algorithmic foundations, as well as innovative advancements in fields like robotics, computer vision, intelligent systems, and bioinformatics (ACM, n.d.; Wabwoba & Nambiro, 2018).

CS education offers a strong base for graduates to keep up with new technologies and novel ideas. ACM (n.d.) classifies the work of computer scientists into three main areas: creating and building software, developing efficient approaches to computing issues (e.g., data storage in databases, secure data transmission), and exploring innovative applications of computers in specialized fields such as digital forensics or robotics among others. However, these specializations may not be available in all CS degrees. Understanding of mathematics is necessary for the majority of CS programs (ACM, n.d.). The deployment and support of software for businesses are often not handled by CS, which has a smaller role in the development of software applications. It is seen as a more theoretical and research-focused computer discipline (Ramos-Torres, 2018).

There is a significant overlap between Computer Science and Software Engineering (SE). Both disciplines place considerable emphasis on software development, whether it involves creating operating systems, standalone applications, law enforcement programs, video games, or other software systems. However, Computer Science delves more into robotics, bioinformatics, and novel uses of computers, while Software Engineering primarily focuses on software systems (Ramos-Torres, 2018).

Information Systems (IS)

In today's technology-driven era, Information Systems (IS) has emerged as a vital computing discipline. IS focuses on creating computer-based systems that allow organizations to analyze, design, and manage their data efficiently. (Bharadwaj et al., 2013). The primary focus of Information Systems is on utilizing computer systems to provide valuable information to support the goals and processes of businesses, non-profit organizations, and governmental entities. It also encompasses the implementation and improvement of enterprise processes through information technology (ACM, n.d.; Wabwoba & Nambiro, 2018).

IS professionals serve as crucial intermediaries between the technical and managerial aspects of organizations. They translate computing-related information and ideas into viable business strategies, bridging the gap between technology and management (Galliers & Leidner, 2014; ACM, n.d.). The role of IS has become increasingly significant, as it aids organizations in their digital transformation and enhances decision-making processes through data-driven insights (Bharadwaj et al., 2013).

However, the growing prominence of IS as a distinct discipline has led to questions regarding its relationship with other disciplines, such as CS and SE (Galliers & Leidner, 2014). IS specialists are responsible for selecting and acquiring computer scientists's of t ware items, as well as integrating software engineers'applications. They deploy these products in addition to the infrastructure provided by IT professionals, thus ensuring proper integration, support, and utilization of computing resources to generate the necessary information for effective and efficient organizational operations (Ramos-Torres, 2018).

Within the realm of IS, job titles commonly include System Administrators or Network Engineers, reflecting the hands-on roles involved in managing and maintaining information systems.

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Software Engineering (SE)

Software Engineering (SE) is a specialized discipline dedicated to the design, development, and maintenance of software systems (ACM, n.d.; Wabwoba & Nambiro, 2018). It applies engineering principles to the creation of software, encompassing activities such as requirement analysis, system design, programming, testing, and project management. The primary objective of software engineering is to produce software systems that are of high quality, reliability, and efficiency. This field plays a crucial role in supporting the software applications that enable various operations in businesses, institutions, and daily life.

According to ACM (n.d.) the creation and maintenance of software products, such as operating systems are SE's primary area of interest. It is particularly significant due to the impact of large and complex software systems and the critical position of software applications (ACM, n.d.). SE is often considered customer-oriented, as it frequently involves developing software products for clients. While Computer Science and Software Engineering share a strong emphasis on software, they also have distinct roles and niches within the broader computing domain.

Research conducted by Wabwoba & Nambiro (2018) revealed some of the key programs covered in software engineering education to include: Software Evolution and Maintenance, Software Design, Verification and Validation.

SE is a unique discipline that distinguishes itself from other engineering fields because software is intangible in nature and has a shorter lifespan. It involves the integration of mathematical and computer science principles with engineering practices used for physical objects. According to Wabwoba & Nambiro (2018), the emphasis of SE involves large-scale system development, testing of the system, and overseeing complex technological initiatives. Additionally, SE differs from CE as it does not involve the development of computer hardware (Ramos-Torres, 2018).

Within the realm of software engineering, common job titles include Software Developer, Senior Software Engineer, Software Engineer II and Programmer Analyst. However, the specific roles and responsibilities can vary significantly across different companies. For example, one company may seek a Software Developer proficient in C++ and .NET frameworks, while another may prefer a Software Developer/Engineer with expertise in C#, Java, and Python (ACM, n.d.).

Students interested in SE can pursue it in two contexts; either as CS programs that offer SE courses as part of their curriculum, or they can opt for a dedicated SE programs. Although CS and SE degree programs often share many courses, SE places a stronger emphasis on software development beyond programming. It includes activities such as gathering of customer requirements, designing and testing the software, and learning how to identify client's needs and creation of software that meets those needs (ACM, n.d.).

Computer engineering (CE)

Computer Engineering (CE) is an interdisciplinary field combining principles from EE and CS to focus on designing and optimizing computer hardware and software systems (Wabwoba & Ikoha, 2011). CE plays a pivotal role in advancing technological hardware and driving innovation in computer and electronic systems. The field encompasses areas such as digital system design, microprocessor systems, and embedded systems programming.

CE's foundation lies in the study of hardware, software, and their interactions. The academic curriculum in CE emphasizes theories, principles, and methodologies from traditional EE and maths, applying to address challenges in computer design and a wide range of computer-centric devices (Computer Engineering

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Curricula, 2016, as cited in Wabwoba & Nambiro, 2018).

Students pursuing Computer Engineering delve into the development of the hardware and software of various digital devices, computers and communication systems. (Wabwoba & Nambiro, 2018; ACM, n.d.). The curriculum also encompasses software development, with a particular focus on the software that runs the created digital devices, rather than end-user software programs. (Ramos-Torres, 2018). The curriculum strikes a balance by leaning towards hardware components while maintaining a strong engineering perspective.

Embedded systems have emerged as a prominent area within computer engineering, where software components are deeply integrated into hardware. This field encompasses devices such as mobile phones, digital recorders and others which demand seamless hardware and embedded software integration. CE plays a vital role in designing hardware to facilitate communication systems, creating hardware devices like iPods, and integrating computer hardware and software (Wabwoba & Nambiro, 2018). A solid foundation in mathematics is crucial for success in this field.

Among the various disciplines, Computer Engineering holds a unique and indispensable position as it serves as the backbone for the functioning of the other computing domains.

In the job market, positions such as Computer Engineer, Embedded Software Engineer or Firmware Engineer are highly sought after within the Computer Engineering sector.

Information Technology (IT)

Information Technology (IT) is a dynamic field within computing that involves using different areas of computing to tackle problems faced by organizations. (ACM and IEEE, 2017). IT education emphasizes practical knowledge and hands-on experience, equipping graduates with the skills to efficiently manage computing infrastructures (Brey & Søraker, 2009; ACM, n.d.). IT professionals possess a combination of technical expertise and practical problem-solving abilities to oversee an organization's IT infrastructure and support its end-users. Their responsibilities include selecting suitable hardware and software products, integrating them into the organizational infrastructure, and ensuring the installation, customization, and maintenance of applications to create a secure and effective computing environment for the organization's users (ACM, n.d.; Ramos Torres, 2018).

IT uses systems software, application software, and hardware already in place to develop effective and practical solutions. (Lunt & Ekstrom, 2008; Information Technology Curricula, 2017 as cited in Wabwoba & Nambiro, 2018; Ramos-Torres, 2018).IT pay slessemphas is on the information or content solution. (Ramos-Torres, 2018)

Managing servers, desktops, communication networks, operating systems, and platform applications like office systems, email, and web-related software are all part of the IT process. (Ramos-Torres, 2018).

IT overlaps with the other disciplines due to the fact IT professionals work towards deploying and supporting existing products developed by CE, CS and SE rather than developing new products themselves (Ramos-Torres, 2018).

IT courses equipsits students with the necessary skills to fulfill the technological needs of companies and various institutions, making IT professionals adept at fulfilling organizational technology needs. (Wabwoba and Nambiro, 2018)

Compared to other computing fields, Information Technology is relatively young but continues to evolve

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rapidly, driven by technological advancements and societal demands (ACM and IEEE, 2017; Gichuki et al., 2019).

While there may be some overlap between Information Systems and Information Technology, an informed individual can distinguish their distinct characteristics. An IS specialist aims to meet the information-related needs of businesses, while an Information Technology specialist focuses on the technology or hardware aspect. Both disciplines prioritize addressing business needs, with the former focusing on efficient system implementation and the latter resolving issues within those systems.

Common professional designations within the field of Information Technology include Information Systems Specialist, Information Technology Specialist, IT Manager, IT Project Manager, and IT Consultant, reflecting the diverse roles and responsibilities within the sector.

Information and Communication Technology (ICT)

The classification of computing disciplines, as outlined by ACM in 2016, encompasses five well-established areas. However, the rapid evolution of the field has given rise to a sixth discipline, Information and Communication Technology (ICT), which is currently in the process of defining its distinct philosophical foundations.

Despite facing resistance and skepticism in some countries, ICT stands as a discipline that extends beyond the traditional boundaries of Information Technology. Critics often perceive ICT as a mere extension of Information Technology, disregarding its unique characteristics and contributions. However, a closer examination reveals that ICT possesses its own philosophical principles that set it apart.

ICT is a multifaceted discipline that serves as a bridge between technological solutions and business processes, catering to the information communication needs of various institutions. Its specialists are dedicated to harnessing technology to enable efficient and effective information communication. ICT offers an innovative perspective on information technology, placing a primary emphasis on communication and recognizing technology as a powerful tool for processing and disseminating information.

Professionals working within the ICT discipline focus on utilizing computerized systems to facilitate enterprise communication and support the achievement of strategic goals. They actively engage in identifying and implementing communication processes that organizations can refine or establish through the deployment of information technology. By doing so, ICT professionals contribute to enhancing the effectiveness and efficiency of business operations, ultimately fostering the growth and success of enterprises (Wabwoba & Nambiro, 2018).

The field of ICT encompasses a wide range of roles and responsibilities. Some common job titles within the ICT sector include ICT Specialist, ICT Manager, ICT Consultant, and ICT Project Manager. These professionals play crucial roles in integrating technology with communication processes to meet the diverse needs of organizations.

Emerging Computing disciplines: Current and Emerging Technologies

Computing technology has evolved into a vast and diverse field, encompassing a wide range of subareas that address different aspects of computing technology. These subareas have emerged over time, driven by the advancement of hardware and software, the development of new computational methods, and the growing demand for solutions to complex problems in various domains. (Clear, A. et. al 2017)

The ACM/IEEE Computing Curriculum (CC) 2005 reports that there are five major computing disciplines

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namely: Computer Science (CS), Computer Engineering (CE), Information Systems (IS), Information Technology (IT), and Software Engineering (SE).

In the later ACM/IEEE CC2020 report, it has increased the number of recognized computing discipline to seven disciplines, adding Cyber ??Security (CSEC), Data Science (DS) and Other emerging disciplines, to the initial five disciplines

Cybersecurity jobs are predicted to grow by 28 percent between 2016 and 2026, much faster than average for all occupations [*5 Trends in Computer Science Research*. (n.d.).]. This is due to the increasing number of cyberattacks threatening businesses as the use of big data and AI expands [*Top Trends in Computer Science Careers*, (n.d.)].

Data science is an emerging trend in computing disciplines that involves the extraction, analysis, and interpretation of data to gain insights and make informed decisions [Cao, L. (2017)]

The data science draft DS202x from the CC2020 report proposes a comprehensive competency framework for data science degree programs, encompassing nine key knowledge areas including:

1. Data privacy, security, and integrity: This area emphasizes the importance of protecting data from unauthorized access, ensuring its confidentiality, integrity, and availability.
2. Machine learning: This area explores the principles and techniques of machine learning algorithms, including supervised and unsupervised learning methods.
3. Data mining: This area focuses on extracting patterns and knowledge from large datasets using data mining techniques, such as association rule mining and clustering.
4. Big data: This area deals with the challenges and opportunities associated with handling and analyzing massive datasets, including techniques for data processing and analysis at scale.
5. Analysis and presentation: This area emphasizes the ability to effectively analyze and communicate insights derived from data using appropriate visualizations and storytelling techniques.

According to the CC2020 report, the four domains of computing technology discussed below are already present, but they have not yet attained the status of an academic discipline. The domains may be recognized within a region or country, but esteemed institutions like ACM or IEEE have not yet endorse them.

1. IoT connects digital technologies with physical objects that allows them to create computational capabilities and act independently or with little human intervention.
2. Cloud computing, provides computing capacity (especially data processing/storage capacity) over the internet or other networks. It is usually charged on a per-use basis and is managed by a service provider.
3. Artificial Intelligence (AI) and Robotics Today, AI is being used in many systems to support and facilitate human decision-making. It is important to note that strong AI and artificial super intelligence (a form of AI that mimics and potentially surpasses human capabilities) are currently not available. However, there is an increasing debate in this field, especially from an ethical point of view. Robotics brings together expertise from many areas over recent decades to create non-human artifacts that can perform a wide variety of tasks in more and more contexts.
4. HPC (high-performance computing) processes data and does complex calculations at billions of calculations per second. This is much faster than a traditional high-speed computer. HPC is relevant in a wide range of computing domains, including CA, DSE, IoT, etc. Teaching HPC applications is difficult due to the wide range of areas covered by them.

Other emerging trends in computing include virtual and augmented reality (VR/AR), 5G. Other new computing technologies considered as key emerging technologies (Clear, A. et. al 2017).

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1. User interfaces are evolving from traditional click/tap controls to more natural ways of interacting, like speaking and gesturing. These often combine with other capabilities to enhance human experiences.
2. Cognitive technologies is a broad term for various AI capabilities that can address complex organizational and societal challenges.
3. Blockchain or distributed ledger technologies allow different parties to maintain a shared, verifiable, and permanent record of transactions in a distributed data storage environment.
4. Quantum computing leverages quantum phenomena at the subatomic level across many academic disciplines and industry labs to enable a new computing model that can solve complex problems not possible with traditional computing.
5. Bioinformatics studies, stores, and analyzes biological information. A multidisciplinary subfield combining computer science and biology, bioinformatics looks for patterns in sequences of genetic material like DNA, genes, RNA, and protein. [*5 Trends in Computer Science Research*. (n.d.).]

SIMPLIFYING THE DILEMMA FOR COMPUTING DISCIPLINE

From the above literature review, it can be noted that choosing a specific discipline within the broad field of computing can be a challenging task, given the varied and overlapping areas of expertise. To simplify this decision-making process, it is therefore important to understand the distinctions and convergences among the key computing disciplines: Computer Engineering, Computer Science, Software Engineering, Information Technology, Information Systems and Information Communication Technology.

This paper seeks to demystify these disciplines by providing a comprehensive comparison, allowing prospective students and professionals to align their interests, career aspirations, and skills with the most suitable discipline. This is done through tabulating the information discussed above, which is collected from various literature.

The below table provides a summary of the key disciplines, their brief description, programs of study, career path as discussed by various researchers.

Table 1: Simplifying the Computing Disciplines

	DISCIPLINE	**BRIEF DESCRIPTION**	**SOME OF THE TOPICS OR ISSUE OF STUDIES**	**CAREER PATH / ACADEMIC SCHOOL**	**REFERENCES**
1	**Computer Science (CS)**	Covers a wide range of topic which is classified into 3 major issues: • designing and building software; • developing effective approaches to computing issues, • Exploring innovative applications of computers • Difference with CE is that it does not	• Algorithms • Operating Systems • Programming Languages	**Career Path** • Software developer (Bachelors Level) • Research & Development (R &D) Laboratory (Need Masters) • Research Department in University or Industrial R& D (Need PHD)	ACM, n.d.; Wabwoba & Nambiro, 2018; Ramos- Torres, 2018.

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		involve hardware development.		**Academic School** • Its Programs are usually found in the Science School	
2	**Information Systems (IS)**	IS involves utilizing computer systems to provide valuable information to support the goals and processes of businesses, non-profit organizations, and governmental entities. It is an overlap between: • CS • SE • IT Big difference from other discipline like CS is that it does not involve hardware or software development.	• Information Management Practices • Information Systems • Analysis of business requirements • Management of Information Systems Organization	**Career Path** Similar path as that of IT program including: • System Administrators • Network Engineer **Academic School** • This discipline is mostly found in Business School	ACM, n.d.; Wabwoba & Nambiro, 2018; Ramos- Torres, 2018; Bharadwaj, et al., 2013; Galliers & Leidner, 2014;
3	**Software Engineering (SE)**	It is a specialized discipline dedicated to the design, development, and maintenance of software systems. SE is different from other engineering disciplines due to the fact that software is intangible in nature and has a shorter lifespan Different from CE as it does not involve the development of Hardware	• Software modeling and analysis, • Software design, • Software verification and validation, • Software process.	**Career Path:** • Software Developer, • Senior Software Engineer, • Software Engineer II • and Programmer Analyst **Academic School** • Its programs are found in several schools such as School of Engineering and the School of Science • It may also be found within the CS department, either as a separate	ACM, n.d.; Wabwoba&Nambiro, 2018; Ramos- Torres, 2018.

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				program or combined with CS	
4	**Computer Engineering (CE)**	CE focuses on the development of the hardware and software of various digital devices, computers and communication systems. This is interdisciplinary domain that intertwines the principles of EE and CS, principally focusing on the creation and optimization of computer hardware and software systems. Unlike SE, the emphasis of CE is mostly in hardware, software is not addressed as a goal by itself, but rather as an important component for the hardware that is created. CE stands out as the most unique and indispensable, as it forms the backbone for the functioning of the other four disciplines	• Computer Architecture • Computer Systems Engineering • Digital logic • Requires significant study of Mathematics	**Career Path** • Computer Engineer • Embedded Software Engineer • Firmware Engineer **Academic School** • This discipline is mostly found in Engineering school	Wabwoba & Ikoha, 2011; Computer Engineering Curricula 2016; Ramos-Torres, 2018; Wabwoba & Nambiro, 2018; ACM nd
5	**Information Technology (IT)**	IT is the youngest in the computing landscape, compared to other fields. IT involves the usage of existinghardware & software and other technologies in providing solutions for organization. IT professionals	• Platform Technologies • Security Implementation & Management • Human Computer Interaction • System Integration • Technical Support	**Career Path** • IS Specialist, • IT Specialist, • IT Manager, • IT Project Manager • IT Consultant, **Academic School** • IT programs are located in several schools such	ACM and IEEE, 2017; Gichuki et al, 2019; Wabwoba&Nambiro, 2018; Information Technology Curricula 2017; Ramos-Torres, 2018

		therefore use existing products developed by CE, CS, & SE rather than developing new products themselves		as: School of Engineering and Business and as an independent institute	
6	**Information Communication Technology (ICT)**	ICT offers an innovative perspective on information technology, placing a primary emphasis on communication and recognizing technology as a powerful tool for processing and disseminating information.	Networking, Media, Technical communications, Web management, Enterprise systems	**Career Path** • ICT Specialist • ICT Manager • ICT Consultant • ICT Project Manager **Academic School** • Similar to IT program, this is found in several schools such as School of Engineering and Business and as an independent institute	Wabwoba&Nambiro 2018

Table adapted from: Ramos-Torres, A. I. (2018), Main Computing Disciplines: Characteristics, Similarities, and Differences. *Rock Solid*

SUMMARY AND CONCLUSION

The complex and ever-evolving sphere of computing disciplines undeniably forms the backbone of the progressively digital society we exist in today. There exists an imperative, yet attainable, need to unravel these key disciplines. This study offers insightful information, suggesting that the dilemma of the computing disciplines can be more efficiently traversed through strategic intervention.

Though the paper discussed on the 6 key computing disciplines; the focus was mainly on the five key disciplines as per ACM 2016. The study on the new disciplines of ICT is still ongoing; there fore future study can dig deeper into this discipline.

As we navigate further into the 21st century, the imperative of comprehending and simplifying the computing disciplines escalates. Ensuring these disciplines are accessible and approachable is vital, as it empowers individuals to comprehend, participate in, and influence the shape of our steadily digitalized world. The task may be formidable, but the potential rewards are more informed society and an inclusive digital future are indeed meritorious of the end eavour.

Thus, the paper through collection of various literature tried to simplify the dilemma for the computing disciplines.

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